tional." As a result of long observation we know that shielding is a common practise with nesting birds. It is probably something more than a heat-reflex, since it is most characteristic of the later period of nest-life, when it succeeds the more familiar brooding "habit." This spreading over the young, or shielding attitude, is useful like the other instincts, but whether it is "intentional" or not is quite aside from the main question. We might even have to qualify any sweeping statement that *brooding* was intentional. "Spreading," when away from the nest, is undoubtedly a reflex, and is often apparently due to heat, but birds will spread in a similar manner to dry off when wet.

Young ospreys are fed at long intervals, not oftener than twice or three times a day, though the rate of feeding possibly may vary somewhat with age. At one nest which the author carefully watched, meals were served at 7 P.M. and at 4.15 A.M. and 7 P.M. on the following day. At night the male guards the nest, while its mate broods.

The osprey is said by fishermen to descend four or five feet in the water to strike the flounder, which is often seen in its talons. Fish are always carried head foremost, either the bird's right or left foot being directed forward. It will be interesting to note that the largest capture which Audubon directly observed, was a weak-fish, weighing upwards of five pounds. This bird, he remarked, was barely able to rise from the water, and when shot at it immediately dropped its quarry. Moreover, it was this large and perfect specimen which Audubon introduced into his plate.

Nest-building begins in May and additions to the structure are made throughout the season. A nest once built and occupied is commonly held as a rightful and individual possession, and the structure tends to increase in bulk from year to year. The writer, however, finds that this is not invariably the case, and much more exact knowledge on the history of such nests is greatly needed. A nest of the osprey which was removed from Gardiner's Island to the New York Zoological Garden weighed 400 pounds and it is thought that the largest nests may even reach the weight of half a ton. At this island the eggs are laid early in May, and two to three in number. Incubation lasts from 24 to 28 days, the young ospreys emerging in close furry down. Nest-life lasts from 5 to 6 weeks, and is over by early August.

We do not for a moment believe that ospreys or any other wild birds suffer the "mental anguish" about their young which the writer generously attributes to them, but we are not disposed to be overexacting with work conscientiously done, and especially when a good moral lesson is enforced.

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A Text-book of Botany for Colleges and Universities. By members of the Botanical Staff of the University of Chicago, JOHN MERLE COULTER, Ph.D., Professor of Plant Morphology; CHARLES REID BARNES, Ph.D., Late Professor of Plant Physiology; HENRY CHANDLER COWLES, Ph.D., Associate Professor of Plant Ecology. Vol. II. Ecology. New York, Cincinnati and Chicago. American Book Company, octavo. Pp. x + 485 to 964 + 17.

A little more than a year ago the present writer noticed the first volume (Parts I. and II.) of this notable contribution to the American text-books of botany (SCIENCE, January 6, 1911), and suggested the probable early appearance of Part III. This saw the light about the holidays, and has been before the botanists of the country long enough to have already taken its place as one of the standard texts in its special department of botany. No doubt the first feeling of every botanist was one of surprise at the quite different mode of treatment given to the subject from that which has heretofore been accorded it. Some things hitherto regarded as ecological are entirely left out in Dr. Cowles's treatment or given very little emphasis. No doubt many an "ecologist" will rub his eyes as he looks about him in certain chapters for something familiar.

In an introductory chapter the author discusses his problem in such manner as to help us to see it from his point of view, starting with the remark that "ecology is a science in its beginnings." A little later he says "nor is it possible as yet to mark out its limits, for it overlaps to a greater or less degree every other field of biology and of physiography and geology as well." In spite of these difficulties he ventures a definition of ecology as "that phase of biology that endeavors to explain the origin, variation and rôle of plant or animal structures, and the origin and variation of plant or animal associations." This introductory chapter ought in fact to be very carefully read and reread by the student who wishes to know what it is that Dr. Cowles is putting before him under the name "ecology," for it will be evident very early in the use of the book that it is not at all like those that have preceded it, which means that this "ecology" is not the "ecology" of many other authors.

The general plan of the book may be seen in an enumeration of the contents of the eight chapters, as follows: (I.) Roots and Rhizoids; (II.) Leaves; (III.) Stems; (IV.) Saprophytisms and Symbiosis; (V.) Reproduction and Dispersal; (VI.) Germination; (VII.) Plant Associations; (VIII.) Adaptation. If now the student will read carefully any of these chapters he will find that they deal almost entirely with structure and behavior, and it appears to be the author's deliberate purpose to present these as the material upon which the beginner in ecology is to work. That is, Dr. Cowles bases ecology upon morphology and physiology, just as some of us have been insisting for these past years during which a certain type of ecologists were leading wholly unprepared young people into hazy observations in the field.

It is noticeable that the author has pretty fully eliminated teleology, which had become so conspicuous in the ecological writings of some botanists, reminding one in extreme cases of the botany of the early part of the nineteenth century. This revival of teleology by the younger generation was not a little disquieting to the older botanists, who rightly felt that it was a backward step in the science to return to a view or doctrine that had only so recently been abandoned. In Dr. Cowles's book there is no conscious leaning toward teleology, and for this scientific men owe him a debt of gratitude.

In like manner the author has subordinated the geographical phases of the subject, giving some portions scant notice. He has chosen to emphasize the plant individually, rather than the mass of individuals constituting a particular community of plants. This no doubt contributes to clearness and definiteness and there can be no question that the students who approach ecological studies from this side and in this manner will have much more lucid notions on the subject than those who were taken directly into the field for the study of "vegetation" and "formations." It will be interesting to see what effect this presentation of ecology will have upon its study in high schools and the smaller colleges, where too often it had degenerated into vapid lectures on the general aspects of the vegetational landscape much after the fashion of those formerly given to young ladies who "took botany" in the old-time female seminaries of a century ago.

One of the most helpful and suggestive chapters is that on Saphrophytism and Symbiosis (IV.), dealing as it does with all phases of the structural and physiological relation of the two organisms concerned. The treatment here is clear, and well calculated to lay a solid foundation in the mind of the beginner.

In the fifth chapter (Reproduction and Dispersal), while by far the greatest attention is given to these phenomena in the flowering plants, the subject is introduced by twenty pages on the behavior of the lower plants, the author's idea evidently being that even lower plants are worth while ecologically, especially as they are simpler and more easily understood. The treatment throughout the chapter has an air of freshness that is gratifying, much of the matter having been developed by the author in connection with his class work.

The short chapter on plant associations,

eight pages in all, will be disappointing to old-time ecologists, to whom, however, its brevity should be a suggestion that they have hitherto given overmuch emphasis to this phase of the subject.

A thoughtful chapter on "adaptation," in which the author gives his personal views on the subject, closes the book in such a manner as to leave the student in a properly humble state of mind, since it makes it clear that many of the "cock sure" conclusions of yesterday are improbable, or quite impossible.

A most useful, ten-page appendix contains a classified bibliography which will prove very useful to the student who wishes to go farther than the study suggested in the text.

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SPECIAL ARTICLES

THE PHOTOELECTRIC EFFECT

Readers of Science may be interested in the following brief summary of some of the principal results of an investigation of the magnitude and distribution of the total kinetic energy of the electrons emitted when light falls on metals, considered as a function of the frequency of the light and of the nature of the metal. A fuller account of the investigation was communicated to the meeting of the American Physical Society at Boston on April 27.

Monochromatic ultraviolet light of various wave-lengths from a quartz-mercury arc lamp was allowed to fall on a small strip of the metal to be tested placed at the center of an exhausted conducting sphere. Measurements of the currents against various opposing potentials enable the distribution of the energy among the emitted electrons to be obtained directly. The experimental results may be analyzed and exhibited graphically by plotting the number of electrons having a given energy against the energy. These curves are nearly symmetrical about the axis of mean energy. The mean energy is very close to the most probable value of the energy. The probability of an electron having energy within a given range changes very rapidly in the neighborhood, both of the maximum energy and of zero energy. The maximum energy, and also the range of energy, of the electrons emitted by light of a given frequency is approximately a linear function of the frequency.

For different substances the relation between the mean energy Tv and the frequency v of the exciting light is found to be $Tv = k_1(v - v_0)$. For sodium, magnesium, zinc, aluminium, tin and platinum $k_1 = 2.9 \times 10^{-27}$ erg. sec. v_0 is a constant characteristic of the substance. The above formula is a particular case of a more general relation $Tv = v\phi(v_0/v)$, where ϕ is a universal function of the argument, which was deduced theoretically by one of the writers. According to the theory the values of v_0 should be calculable from Planck's radiation constant h and the intrinsic potentials of the substances. The calculated values of $\lambda_0 = c/v_0$ are compared with those given by the photoelectric measurements in the following table:

	Na	Al	Mg	Zn	Sn	Bi	Cu	Pt
λ_0 (calculated)....	52.6	36.0	34.6	33.3	31.0	29.4	28.0	27.3
λ_0 (photoelectric)	57.0	39.5	36.5	36.1	33.8	33.1	29.7	29.0

Our measurements of the maximum energy Tm are probably less accurate and certainly more irregular than those of the mean energy; but they are all fairly near the linear relation $Tm = k_2(v - v_0)$. The values of v_0 are the same as before and k_2 is very near to 6×10^{-27} erg. sec. k_2 is thus about 10 per cent. less than Planck's constant h. We do not, however, wish to emphasize this difference, pending further investigation, as we realize that the accurate measurement of the maximum energy is a rather difficult problem. Bismuth and copper appear to have smaller values of both k_1 and k_2 than the other metals, but here again it is possible that further research will remove the difference.

If the laws which we have found to connect the frequency of the light with the maximum and mean energy of the liberated electrons hold up to the highest frequencies, it follows